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The composition of fats (Item No.: P7185600)



Task and equipment

Information for teachers

Additional Information

Fats play an important role in a healthy diet. What is to be understood by saturated and unsaturated fatty acids?

Notes on content and learning objectives

- Fats are esters of glycerol and various fatty acids.
- Alkali splits fats into their constituents, glycerol and fatty acids. Fatty acids form soaps with sodium ions.
- Glycerol is a trivalent alcohol, which can be oxidized to aldehyde and then gives a positve reaction with Schiff's reagent.

Notes on the method

A basic knowledge of organic chemistry is necessary to be able to answer questions 3 and 4.

Fundamentals and remarks

Natural fas are mainly esters of glycerol and various even numbered, unbranched fatty acids, so-called triglycerides. As a rule, fats are complemented by numerous accompanying substances, such as waxes, lipovitamines and lecithins. Pure fats can be indentified by their characteristic fatty acid pattern. For this, they are saponified, the fatty esters esterfied and the fatty acid patterns subsequently determined by capillary gas chromatography. Fatty acids of the chain length C-16 and C-18 are found particularly frequently in vegetable and animal fats.

Hints on going deeper

• A connection to biology can be made here. Fats are spoken on when in the subject metabolism.

Notes on set-up and procedure

Preparation:

The detection reactions for fatty acids or glycerol can be demonstrated using the appropriate reference substances, e.g. palmitic acid (Order No. 31698-25) or glycerol (Order No. 30084-25), or be carried out in parallel by the students.

Notes on the students experiment:

The experiment should be carried out in a fume cupboard whenever possible, as when fats are heated, acrolein, a substance with a pungent smell, can be given off.



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Teacher's/Lecturer's Sheet

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Hazard and Precautionary statements

Ethanol:	
H225:	Highly flammable liquid and vapour.
P210:	Keep away from heat/sparks/open flames/hot surfaces - No smoking.
Potassium hydrogen sulphate:	
H314:	Causes severe skin burns and eye damage.
H335:	May cause respiratory irritation.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P309 + P310:	IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.
Caustic soda solution (sodium hydroxide in water):	
H314:	Causes severe skin burns and eye damage.
H290:	May be corrosive to metals.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P309 + P310:	IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
Schiff's reagent:	
H314:	Causes severe skin burns and eye damage.
H350:	May cause cancer.
P201:	Obtain special instructions before use.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P308 + P313:	IF exposed or concerned: Get medical advice/attention.

Hazards

- Ethanol is highly inflammable. Extinguish all open flames. Close and remove all bottles after having used them.
- Sodum hydroxide solutions are caustid.
- Do not allow liquids to contact skin, eyer or clothing.
- Wear protective gloves and protective glasses!
- Carry out the experiment in a fume cupboard if possible.

Waste disposal

After dilution with water, the solutions in the test tubes can be poured to drain in the fume cupboard.



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Task and equipment

Task

Which organic compounds is fat composed off?

Determine from which two types of compounds fat is composed.





Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, I=370 mm, d=10 mm	02059-00	1
3	Ring with boss head, i. d. = 10 cm	37701-01	1
4	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
5	Glass beaker DURAN®, short, 400 ml	36014-00	1
6	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
7	Test tube, 180x18 mm,100pcs	37658-10	(3)
8	Test tube holder, up to d 22mm	38823-00	1
9	Test tube brush w. wool tip,d25mm	38762-00	1
10	Wash bottle, 250 ml, plastic	33930-00	1
11	Students thermometer,-10+110°C, l = 180 mm	38005-02	1
12	Pipette with rubber bulb	64701-00	4
13	Spoon, special steel	33398-00	1
14	Glass rod, boro 3.3, l=200mm, d=6mm	40485-04	1
15	Labor pencil, waterproof	38711-00	1
16	Protecting glasses, clear glass	39316-00	1
17	Rubber gloves, size S (7)	39325-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane catridge CV 300 Plus, 240 g	47538-01	1
	Ethanol extra pure ab.95% 1000 ml	30008-70	1
	Caustic soda sol. 32% 1000 ml	30266-70	1
	Water, distilled 5 l	31246-81	1
	Potass.hydrogen sulphate 250 g	31439-25	1
	Schiff's reagent 250 ml	31827-25	1
	Boiling beads, 200 g	36937-20	1
Additional material			
	Vegetable oil (sunflower oil, olive oil,)		



Set-up and procedure

Set-up

Hazards

- Ethanol is highly inflammable. Extinguish all open flames. Close and remove all bottles after having used them.
- Sodium hydroxide solutions are caustic.
- Do not allow liquids to contact skin, eyes or clothing.
- Wear protective gloves and protective glasses!
- Carry out the experiment in a fume cupboard if possible.



Setup

Number four test tubes from 1 to 3 and stand them next to each other in the test tube rack (Fig. 1).



Assemble the stand as shown in figures 2 to 6. Fasten the support ring to the support rod and place the wire gauze on it. Adjust the height of the support ring so that the flame of the burner just reaches the wire gauze.



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Student's Sheet

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Fig. 3





Half-fill a 400 ml beaker with water and add a few boiling stones. Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!



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Procedure

Pipette approx. 4 drops of vegetable oil into test tube 1 (Fig. 8). Add sodium hydroxide solution to a height of 1 cm, then pipette in the same amount of ethanol.



Put the test tube 1 in the hot water bath which was previously prepared (Fig. 9). Leave it there for about 5 minutes , then take it out and cool it under running water. Fill it up to a height of 5 ml with water. Test of it froths by gently shaking it.



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Pipette the vegetable oil into test tube 2 to a height of 1 cm. Add a spatula tip of potassium hydrogen sulphate (Fig. 10), then heat the test tube for about 5 minutes in the hot water bath. Take the test tube out and stand it in the rack to cool.



Pipette Schiff's reagent into test tube 3 to a height of 2 cm. Add approx. 4 drops of the cooled solution from test tube 2. Place test tube 3 in the hot water bath for about 3 minutes. Observe any change in colour.

Waste disposal

After dilution with water, the solutions in the test tubes can be poured to drain in the fume cupboard.



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Report: The composition of fats

Result - Observations

Describe your observations in the following succession:

a) Vegetable oil with sodium hydroxide solution and ethanol.

b) Vegetable oil with potassium hydrogen sulphate and Schiff's reagent.

Evaluation - Question 1

Draw conclusions from your observations.

a) Reaction with sodium hydroxide solution and ethanol.

b) Reaction with potassium hydrogen sulphate and Schiff's reagent.



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Evaluation - Question 2

Fill in the missing entries on fatty acids in the following table:

Name	Empirical formula	Structural formula
Palmitic acid	C ₁₆ H ₃₂ O ₂	1
Stearic acid	C ₁₈ H ₃₆ O ₂	1
Butyric acid	1	CH ₃ (CH ₂) ₂ COOH

Evaluation - Question 3

Draw a mixed triglyceride from the three fatty acids listed above and glycerol.



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Evaluation - Question 4

Complete the following statements.

Evaluation - Question 5

Explain how soaps can be prepared.

Evaluation - Question 6

What are the properties of soaps?



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